Md Arif Shaikh

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Postdoctoral researcher focusing on gravitation wave (GW) physics. My current research interests are modelling of eccentric waveforms using Numerical Relativity, GW physics with higher modes, test of general relativity with GW, gravitational lensing of GW. I am a current member of the LIGO Scientific Collaboration and the SXS Collaboration.

Current Position

2019–2022 **Postdoctoral Fellow**, Astrophysical Relativity group, International Centre for Theoretical Sciences
Survey No. 151, Shivakote, Hesaraghatta Hobli, Bengaluru – 560 089, India.
Mentors: Prof. P. Ajith · ajith@icts.res.in, Dr. P. Kumar · prayush@icts.res.in

Education

2014–2019 **PhD**, Harish-Chandra Research Institute, Chhatnag Road, Jhunsi, Prayagraj (Allahabad), India
Thesis Title: On emergent sonic geometry through the linear perturbation of relativistic black hole accretion.
Thesis submitted: June 25, 2019. *Thesis defended*: November 18, 2019
Advisor: Prof. Tapas K. Das · tapas@hri.res.in.

2012–2014 **MSc**, Harish-Chandra Research Institute, Chhatnag Road, Jhunsi, Prayagraj (Allahabad), India
Percentage: 77.05%

2009–2012 **BSc**, Jadavpur University, Kolkata, India.
Percentage: 80.33%

Publications

Short-author publications

9. Singh, M. K., Kapadia, S. J., Divyajyoti, Shaikh, M. A. & Ajith, P., *Improved early-warning estimates of luminosity distance and orbital inclination of compact binary mergers*, Monthly Notices of the Royal Astronomical Society, (2021).

8. Wei, W., Huerta, E. A., Yun, M., Loutrel, N., Shaikh, M. A., Kumar, P., Hass, R. & Kindratenko, V., *Deep Learning with Quantized Neural Networks for Gravitational Wave Forecasting of Eccentric Compact Binary Coalescence*, The Astrophysical Journal, **919**, 82, (2021).

7. Singh, M. K., Kapadia, S. J., Shaikh, M. A., Chatterjee, D. & Ajith, P., *Improved early warning of compact binary mergers using higher modes of gravitational radiation: a population study*, Monthly Notices of the Royal Astronomical Society, **502**, 1612-1622, (2021).

6. Kapadia, S. J., Singh, M. K., Shaikh, M. A., Chatterjee, D. & Ajith, P., *Of Harbingers and Higher Modes: Improved Gravitational-wave Early Warning of Compact Binary Mergers*, The Astrophysical Journal Letters, **898**, L39, (2020).

5. Shaikh, M. A. & Das, T. K., *Linear perturbations of low angular momentum accretion flow in the Kerr metric and the corresponding emergent gravity phenomena*, Phys. Rev. D, **98**, 123022, (2018).

4. Shaikh, M. A., Maity, S., Nag, S. & Das, T. K., *Effective sound speed in relativistic accretion discs around Schwarzschild black holes*, New Astronomy, **69**, 48 - 57, (2019).

3. Datta, S., Shaikh, M. A. & Das, T. K., *Acoustic geometry obtained through the perturbation of the Bernoulli's constant*, New Astronomy, **63**, 65 - 74, (2018).

2. Shaikh, M. A., *Relativistic sonic geometry for isothermal accretion in the Kerr metric*, Classical and Quantum Gravity, **35**, 055002, (2018).

1. Shaikh, M. A., Firdousi, I. & Das, T. K., *Relativistic sonic geometry for isothermal accretion in the Schwarzschild metric*, Classical and Quantum Gravity, **34**, 155008, (2017).

LIGO-VIRGO-KAGRA Collaboration publications

6. The LIGO Scientific Collaboration, The Virgo Collaboration, and The KAGRA Collaboration, *Search for gravitational waves from Scorpius X-1 with a hidden Markov model in O3 LIGO data*, https://arxiv.org/abs/2201.10104, (2022).

5. The LIGO Scientific Collaboration, The Virgo Collaboration, and The KAGRA Collaboration, *All-sky search for continuous gravitational waves from isolated neutron stars using Advanced LIGO and Advanced Virgo O3 data*, https://arxiv.org/abs/2201.00697, (2022).

4. The LIGO Scientific Collaboration, The Virgo Collaboration, and The KAGRA Collaboration, *Tests of General Relativity with GWTC-3*, https://arxiv.org/abs/2112.06861, (2021).

3. The LIGO Scientific Collaboration, The Virgo Collaboration, and The KAGRA Collaboration, *All-sky search for gravitational wave emission from scalar boson clouds around spinning black holes in LIGO O3 data*, https://arxiv.org/abs/2111.15507, (2021).

2. The LIGO Scientific Collaboration, The Virgo Collaboration, and The KAGRA Collaboration, *Searches for Gravitational Waves from Known Pulsars at Two Harmonics in the Second and Third LIGO-Virgo Observing Runs*, https://arxiv.org/abs/2111.13106, (2021).

1. The LIGO Scientific Collaboration, The Virgo Collaboration, and The KAGRA Collaboration, *Constraints on the cosmic expansion history from GWTC-3*, https://arxiv.org/abs/2111.03604, (2021).

Conference, Workshops and Seminars

April 2022 Poster on *Surrogate and hybrid models of eccentric waveforms using numerical relativity*, *765. WE-Heraeus-Seminar: Gravitational Wave and Multimessenger Astronomy*, Bad Honnef, Germany, 25–28 April 2022.

October 2021 *LISC-Continuous Gravitational Waves Workshop (Virtual)*, 25-27 October, 2021.

July 2021 *Summer School on Gravitational-Wave Astronomy*, ICTS-TIFR, Bengaluru, 05-16 July, 2021. (Held online due to Covid19 outbreak).

Feb 2021 Poster on *Probing the evolution of compact binaries using higher modes of gravitational waves*, 39th ASI meeting, 18-23 Feb 2021, (Held online due to Covid19 outbreak).

Dec 2020 *31st meeting of the Indian Association for General Relativity and Gravitation (IAGRG)*, 19-20 Dec 2020, (IIT Gandhinagar. Held online due to Covid19 outbreak).

Sep 2020 *ICERM Fall '20 Workshop 1: Advances and Challenges in Computational Relativity*, 14-18 September 2020, (held online due to Covid19 outbreak.)

Sep 2020 Poster on *Probing evolution history of compact binaries using higher modes of gravitational waves*, September 2020 LVK Meeting, 14-17 September 2020. (To be held online due to Covid19 outbreak.)

Aug 2020 *ICTS workshop on parameter estimation with bilby*, ICTS, Bengaluru, 27-28 August 2020. (To be held online due to covid19 outbreak)

Aug 2020 *Test of General Relativity using Gravitational Waves*, Indian Association for Cultivation of Science, Kolkata and Indian Institute of Technology, Gandhinagar, 13–14 August 2020. (Held online due to Covid19 outbreak).

Jun 2020 *PyCBC Inference Online Workshop 2020*, Max Planck Institute for Gravitational Physics (Albert Einstein Institute), Germany. 25–26 June 2020, (Held online due to Covid19 outbreak)

May 2020 *Gravitational-Wave Open Data Workshop #3*, LIGO-Virgo Collaboration, 26-28 May, 2020. (Held online due to Covid19 outbreak).

May 2020 *Summer School on Gravitational-Wave Astronomy*, ICTS-TIFR, Bengaluru, 18-23 May, 2020. (Held online due to Covid19 outbreak).

Feb 2020 Talk on *Probing the evolution history of compact binaries from higher modes of gravitation waves*, ICTS In-house symposium, ICTS-TIFR, Bengaluru, 17–18 February 2020.

Dec 2019 *Astrophysics of Supermassive Black Holes*, ICTS, Bengaluru, 17–19 December, 2019.

Dec 2019 *Newton Bhabha-Open Data workshop*, IUCAA, Pune, 4–6 December, 2019.

Nov 2019 Talk on *On the emergent sonic geometry through the linear perturbation of relativistic black hole accretion*, Harish-Chandra Research Institute, Prayagraj, 18 November 2019.

Aug 2019 *The Future of Gravitational-Wave Astronomy*, ICTS, Bengaluru, 19–22 August 2019.

Jul 2019 *Summer School on Gravitational-Wave Astronomy*, ICTS, Bengaluru, 15–26 July 2019.

Mar 2019 *Theoretical Aspects of Astroparticle Physics, Cosmology and Gravitation*, the Galileo Galilei Institute for Theoretical Physics, Florence, Italy, 11–22 March 2019

Nov 2018 Talk on *Relativistic acoustic geometry in general relativistic accretion disc around Kerr black holes*, Exploring the Universe: Near Earth Space Science to Extra-Galactic Astronomy, S N Bose National Centre for Basic Sciences, Kolkata, 14–17 November 2018.

Dec 2017 *Black Holes: From Classical to Quantum Gravity*, IIT Gandhinagar, 15–19 December 2017.

Sep 2017 Talk on *Emergence of curved sonic manifold for isothermal accretion in black hole metric*, Young Astronomers Meet, IUCAA, Pune, 11–15 September 2017

Jul 2017 *Summer School on Gravitational-Wave Astronomy*, ICTS, Bengaluru, 17–28 July 2017.

May 2017 Poster on *Relativistic sonic geometry for isothermal accretion in Kerr metric*, 29th meeting of Indian Association of General Relativity and Gravitation (IAGRG), IIT Guwahati, 18–20 May 2017

Mar 2017 Poster on *Emergence of relativistic sonic geometry through perturbation of matter in black hole metric*, 35th meeting of Astronomical Society of India (ASI), Jaipur, 6–10 March 2017.

Awards, Fellowships and others

Feb 2021 Membership of SXS Collaboration.

Aug 2020 Membership of LIGO Scientific Collaboration.

2018 HRI–Infosys Prize for the year 2018 for distinction in research in Astrophysics.

Dec 2017 West Bengal State Eligibility Test (WBSET).

Jun 2017 National Eligibility Test for JRF (NET).

Dec 2016 National Eligibility Test for JRF (NET).

Feb 2017 Graduate Aptitude Test (GATE).

2012–2014	Senior Research Fellowship, DAE, Govt. of India.
2014–2018	Junior Research Fellowship, DAE, Govt. of India.
Jul 2012	Offer for PhD at IUCAA, Pune starting in 2014 (declined).
Jul 2012	Offer for Integrated PhD at NCRA-TIFR, Pune (declined).
Jun 2012	Offer for Integrated PhD at IISc, Bangalore (declined).
May 2012	Offer for M.Sc at IIT Bombay (declined).
Feb 2012	Joint Entrance Screening Test (JEST).
Feb 2012	Joint Admission Test for M.Sc (JAM).
2009–2012	INSPIRE Fellowship, DST, Govt. of India.
2009	16th rank in 10+2 standard examination, West Bengal Board of Secondary Education.
2007	1st rank in 10 standard examination, West Bengal Council of Higher Secondary Education.

Refereeing

- Classical and Quantum Gravity
- The European Physical Journal C

Teaching Assistantship

October 2021	Tutored in the workshop *LISC - Continuous Gravitational Waves Workshop (Virtual)*, 25-27 October 2021.
July 2021	Tutored a course on "**Stochastic gravitational wave background from early universe**" at the *Summer School on Gravitational Wave Astronomy*, July 2021 at ICTS-TIFR, Bengaluru. This course was instructed by Prof. Shi Pi of Kavli Institute for Physics and Mathematics of the Universe, Japan.
Aug–Dec 2020	Tutored a semester course on "**Introduction to General Relativity**", Aug-Dec 2020, ICTS-TIFR, Bengaluru. This course was instructed by Prof. Bala Iyer.
Aug 2020	Tutored in *ICTS workshop on parameter estimation with bilby*, ICTS, Bengaluru, 27-28 August 2020. Workshop repository is here.
May–Jun 2020	Tutored a course on **"Numerical Hydrodynamics"** at the *Summer School on Gravitational Wave Astronomy*, May–June 2020 at ICTS-TIFR, Bengaluru. This course was instructed by Prof. Ian Hawke of University of Southampton.
May 2020	Mentored Mr. Uddeepta Deka, a graduate student at ICTS-TIFR, for his term paper on **"Formation channels of BBHs detected in LIGO"**, May, 2020.

Jan–Apr 2020 Tutored a semester course on **"An Introduction to GW Physics & Astronomy"**, Jan–Apr 2020 at ICTS-TIFR, Bengaluru. This course was instructed by Prof P. Ajith and Prof Bala Iyer.

15–26 Jul 2019 Tutored a course on **"Advanced General Relativity"** at the *Summer School on Gravitational Wave Astronomy*, 15–26 July 2019 at ICTS-TIFR, Bengaluru. This course was instructed by Prof. Sudipta Sarkar of IIT, Gandhinagar, India.

Jan–May 2016 Tutored a semister course on **"Statistical Physics"** at Harish-Chandra Research Institute, Allahabad, Jan–May 2016. The course was instructed by Prof G. V. Pai.

May–Jun 2015 Mentored Mr Soumyadeep Chatterjee, a postgraduate student from IIT Bombay, who was visiting the Cosmology and High Energy Astrophysics group at HRI during May–June 2015. He studied accretion flow in binary star system via Roche lobe overflow.

Visits

Apr 2022 Frank Ohme, Albert Einstein Institute, Max Planck Institute for Gravitational Physics, Hannover, Germany, April 20–April 24, 2022.

Mar–Apr 2022 Harald Pfeiffer, Albert Einstein Institute, Max Planck Institute for Gravitational Physics, Potsdam, Germany, March 20 – April 20, 2022.

Nov 2019 Tapas K. Das, Harish-Chandra Research Institute, Nov 15–25, 2019.

Mar–Apr 2019 P. Ajith, ICTS-TIFR, Bengaluru, March 25–April 6, 2019.

Jun 2018 Subir Gosh, Indian Statistical Institute, Kolkata, 11–22 June 2018.

Feb–Mar 2018 Sankhasubhra Nag, Sarojini Naidu College for Women, Kolkata, 14 February–4 March 2018.

Nov–Dec 2017 S. N. Bose National Centre for Basic Sciences, Kolkata, 18 November–1 December 2017.

Sep–Oct 2017 P. Ajith, ICTS-TIFR, Bengaluru, 27 September–11 October 2017.

Nov 2016 Sagar Chakraborty, IIT Kanpur, 22–23 November 2016.

Sep–Oct 2014 Tarun Souradeep, IUCAA Pune, 6 September–20 October 2014.

Computational Skills

Programming languages Python, Julia, C++, Emacs Lisp, Racket

Scientific software SpEC, Bilby, PyCBC, Matplotlib, Mathematica, LaTeX, Emacs, Gnuplot

Operating systems Linux, MacOS, Windows.

References

- Prof. Tapas Kumar Das (**PhD advisor**)
  Associate Proffesor G
  Harish-Chandra Research Institute
  Chhatnag Road, Jhunsi, Allahabad 211019, India.
  Email: tapas@hri.res.in
  Phone No. (office): +91 5322274321

- Prof. Parameswaran Ajith (**Postdoc mentor**)
  Associate Professor
  International Centre for Theoretical Sciences, Bengaluru, India
  Email: ajith@icts.res.in
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- Prof. Prayush Kumar (**Postdoc mentor**)
  Reader
  International Centre for Theoretical Sciences, Bengaluru, India
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- Dr. Shasvath Kapadia
  Simons Postdoctoral Fellow
  International Centre for Theoretical Sciences, Bengaluru, India
  Email: shasvath.kapadia@icts.res.in

- Dr. Vijay Varma
  Marie Curie Fellow
  Albert Einstein Institute, Potsdam, Germany
  Email: vijay.varma@aei.mpg.de, vijay.varma392@gmail.com

Personal Information

Date of birth	April 18, 1992
Nationality	Indian
Languages	Bengali, English, Hindi.
Marital status	Married.